

## 5.1 Regional investment attractiveness in an unstable and risky environment

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### Abstract

Investment process effectiveness, which along with investment risk and investment potential defines the investment attractiveness of a region, and, therefore, the investment climate, is also characterized by the growth of regional gross product through investments in physical and human capital. The investment attractiveness of a region is determined by comparison of two parameters reflecting the conditions in which investors' activities take place: investment potential and investment risk. The amount of risks associated with investment activities is large, while uncertainty of their occurrence compels investors to evaluate the investment potential of a region as uncertain, too. Eliminating uncertainty in investment risk evaluation and increasing investment attractiveness of regions may be possible through application of logical and stochastic methods of evaluation, to the author's mind.

### Keywords:

Investment attractiveness, risk factor, geographical region, logical stochastic methods.

## 1 INTRODUCTION

The current state of development of many Russia's regions speaks of a need for both national and international investment. Attracting investors to the Russian market is a hard task because attempts to assess regional investment activities have been rather rough than accurate. Unified approaches to interpretation and composition of indicators are inexistent. The worst problem here is that there are no unambiguous assessment of investment climate and risks of a region. A region's investment domain is a combination of interrelated businesses that are all involved in the processes of accumulation, placement and efficient use of capital as part of investment activities. This domain of economy is not homogeneous; it is an intricate development whereby each participant of investment process, proceeding from its economic interest, carries out a purposeful investment activity. Channeling investment to this or that region is dictated by its investment attractiveness and by the level of investment risk. These are the two variables that influence the amount of capital invested in the region. To evaluate investment attractiveness of a region we have to look at the relevant investment potential index, whose formation is considered in the paper. Assessment of investment risk is possible, according to the author, by applying logical stochastic mathematical assessment models. This approach will allow a potential investor to take an informed decision with a minimized risk of getting poor investment results.

## 2 INVESTMENT POTENTIAL OF A REGION

### 2.1 Building the index of investment potential

Investment process effectiveness, which along with investment risk and investment potential defines the investment attractiveness of a region, and, therefore, the investment climate, is also characterized by the growth of

regional gross product through investments in physical and human capital. It should be noted that the growth of gross regional product may be due to a considerable number of factors which, in their turn, depend on the goal that has been defined by existing regional policies and strategy.

Investments in physical and human capital are the two factors that have the greatest impact on the growth of gross regional product. This domain of economy is not homogeneous, it is an intricate process whereby each participant of investment developments, proceeding from its economic interest, carries out a purposeful investment activity playing at times the role of either investor or investment recipient. This is a reason why investment should be viewed as a system, a combination of interrelated businesses, making up a whole, that are interrelated and interacting in the processes of accumulation, placement and efficient use of capital with the aim of its enlarged reproduction. This gives us grounds to recognize that a region's investment activities are a complex system which, on the one hand, is part of a higher level system, and on the other - is itself a combination of elements that are individual sub-systems themselves [2]. Research of the behavior of such a system is needed for a comprehensive assessment of a region's investment climate, the one that could be capable of verifiably and thoroughly defining the investment attractiveness of the region, which eventually may allow us to reveal the investment potential in question and to manage investment risks.

The investment attractiveness of a region is determined by comparison of two parameters reflecting the conditions in which investors' activities take place: investment potential and investment risk. The amount of risks associated with investment activities is large, while uncertainty of their occurrence compels investors to evaluate the investment

potential of a region as uncertain, too. Investment potential is a weighted average of a number of factors, such as:

- the factor of natural resources potential, including sub-factors: the share of the region's population in the total population of the country, divergence of the regional value for population density from the national figure, in-place reserves of the main natural resources;
- the factor of labour resources potential, including sub-factors: the share of the working-age population of the region in the total working-age population of the country; divergence of the regional value for urban population from the national figure;
- the factor of economic potential, including sub-factors: the share of the region's industrial output in the total national figure, the share of regional construction/civil engineering put in place in the total national figure, the share of regional output of the main food products in the total national figure, the share of regional retail turnover in the total national figure;
- the factor of economic development levels, including sub-factors: the ratio of regional per capita industrial output to the national figure, the ratio of regional per capita value of completed construction/civil engineering projects to the national figure, the ratio of regional per capita production of the main types of agricultural products to the national figure, the ratio of regional per capita retail turnover to the national figure;
- the factor of economic activity level, including sub-factors: the ratio of regional growth of industrial output to the total national figure, the ratio of regional growth of the value of completed construction/civil engineering projects to the national figure, the ratio of regional growth of production of the main types of agricultural products to the national figure, the ratio of regional growth of retail turnover to the national figure; the ratio of regional unemployment levels to the total national figure;
- the standard of living factor, including sub-factors: divergence of regional values from the national ratio of per capita cash income to minimum wage; divergence of relevant regional values from the national ratio of average wage to minimum wage;
- the factor of regional financial standing, including sub-factors: divergence of regional values from the national per capita accrued tax, divergence of regional per capita value of received federal budget allocations from the national per capita value of paid federal budget allocations, the specific weight of the number of unprofitable enterprises in the region in the total number of such companies in the country;
- the factor of economic reform, including sub-factors: divergence of the regional value of per capita budget expenses on economic development of the country from national levels, divergence of the regional value of the number of active banks from the total national figure, the specific weight of the number of mixed and private ownership companies.

On the basis of the above facts we can determine the index of investment attractiveness of a region by means of comparison of two parameters reflecting the conditions under which investors are doing their business, i.e. the investment potential and the investment risk [5].

The investment potential of the region is formed of the following indices: natural resource potential, labour potential, economical potential, level of economical development, economical activity, public purchase power, status of regional finances, progress of economical reforms. The indices of investment attractiveness of the region are integral and are calculated as the sum of individual integral indices estimating the effect of group of factors or parameters. The indices are formed by hierarchical principle: individual indices integrate indices or parameters of the lower level.

The individual indices integrate indices or parameters of the lower level or parameters comprehensively reflecting main macroeconomical parameters of the region.

The peculiarity of the method being used is the possibility to use various parameters, including hardly comparable ones. The specific set of initial data is determined proceeding from the specified objective and the availability of the data.

Calculation of integral indices is based on comparison of development levels of the regions with level of development for Russia equated with 1. The values of indices in dimensionless units vary in the range from 0 to 2.

In order that the values of indices fall within the specified range the following conditions are checked during calculation of deviations of regional values of parameters used for calculation of integral indices from their values for Russia:

- in case of positive effect of parameter on the index value (the more the better): if the regional value is less than the value for Russia – the ratio of regional value to value for Russia is calculated; if the regional value is greater than the value for Russia – the ratio of the value for Russia to the regional value is calculated and the result thus obtained is deducted from 2;
- in case of negative effect of parameter on the index value (the more the worse): if the regional value is less than the value for Russia – the ratio of regional value to value for Russia is calculated and the result thus obtained is deducted from 2; if the regional value is greater than the value for Russia – the ratio of the value for Russia to the regional value is calculated.

In order to indicate the significance of the parameters included into index the specific weights of parameters are used. The sum of specific weights of all the parameters is equal to 1. The specific weight values are determined by expert analysis and can be changed depending on significance of one or another parameter at the given moment of time [1].

$$I_j = \sum_{i=1}^n (A_{i,j} / A_i) * d_i,$$

where:

- $I_j$  – integral index of j-th region;
- $A_{i,j}$  – value of i-th parameter for j-th region;
- $A_i$  – value of i-th parameter for Russia as a whole;
- $D_i$  – specific weight of i-th parameter defining its significance among other parameters used for calculation of the index, while:

$$\sum_{i=1}^n d_i = 100\%$$

This approach allows us to define a region's economic health in the situation of risk and uncertainty.

## 2.2 General index of investment potential

Having identified factors influencing investment potential and investment risk, we now have to choose mathematical instruments to assess it.

indicator of investment activity, for integration of indicators of capital availability, capital-labor ratio, yield on capital investment, average education level and performance into a general indicator of investment potential state, and also indicators of investment effectiveness in the region, is the multivariate average method [3,4]. This method has been widely applied for comprehensive regional assessments. Using it we can calculate the generalized factor index for each region. This index is a ratio of the indicator to the average national value taken as 1 or 100%, calculated by Formula 1:

$$K_j = \frac{P_j}{P_{cp}}, \quad (1)$$

where  $P_j$  is the actual value of the  $j$ -factor used for the assessment of investment climate,  $P_{cp}$  is the average value of the  $j$ -factor for a group of studied regions. The specific nature of this method is comparison of per capita regional factors under consideration (investments, yield on capital investment, average education level, etc.) with national average values for the same factor. As a result of the comparison we have normalized per capita values for these factors per region. To obtain more verifiable results we have to somewhat depart from the adopted method. It is necessary to calculate not the arithmetic mean of the used factors, but the length of a vector, whose projections onto the reference frame are the values of the factors taken for integral assessment. Calculation of the length of this vector is done by Formula 2 as follows (2) [6]:

$$V = \sqrt{A^2 + B^2 + C^2 \dots} \quad (2)$$

The resulting vector is present in a  $n$ -dimensional system of coordinates, where  $n$  is the number of factors used. The length of the vector will be a characterization of the integral assessment of investment climate in regions, compared with the average national level. Further on, assessments per region are summarized as one integral indicator.

By ranging regions according to this integral indicator, we will be able to talk about objective, verifiable assessment of investment climate in each of them and about its rank among all other regions of Russia. This indicator allows us to compare variances in the levels of investment climate per region in addition to their individual ranks on this rating scale. Having only these ranks we cannot reveal to which extent one region excels other ones or yields to them, because when we range an attribute between two adjacent regions the variance may be both large or small; ranks do not reveal this.

## 3 SYSTEMIC NATURE OF INVESTMENT RISK

The rate of investment potential is influenced by investment risk, which is a combination of interrelated risk factors defined

as the probability of loss and damage [7]. A loss/damage criterion for us will be the occurrence of events that determine the efficiency of investment process above the acceptable risk level. A risk factor is an accidental event or a group of events that are responsible for this type of risk. In other words, these are the so-called factors and effects of their interaction, which allow us to define that one risk event is produced by one or more risk factors that are damaging to the risk object.

Any risk can be presented as a system, by which word we understand a combination of risk factors with independent effects of their interaction. The investment realm, at the same time, is a closed continuous system of interaction of risk factors, whose structure, properties and management are to be studied. This points to the duality of system building in the investment domain and duality of risk factors influencing the ambiguity of investment results.

To manage investment risks we have to do analysis and assessment based on a range of principles, i.e. methodological, procedural and operational ones.

Methodological principles are defined as conceptual postulates; they do not depend on specific types of risk; these principles are: uniformity of risk types for all participants of investment process, positivity of risks (acceptability of their integral level), risk objectivity (integral monotonicity, disproportionality, transitiveness, additivity), integral nature and interrelation of risks.

Procedural principles are directly linked to the type of business, its properties and characteristics, accepted values and attitudes, specific cases. these principles are: risk discordance, varying risk perceptibility, dynamics and consistency of risks.

Operating principles are linked to the presence, verifiability, unambiguity of data and to instruments of their processing; these principles are: modeling and simplifying risks.

To analyze and assess risks the system research approach was used. All approaches to system research can be either analytical or synthetic, which in their turn break down into: analysis – functional or structural, synthesis – emergent (that defines coherence of a system) or synergetic (co-acting, multiplicative effect). To reveal "emergent" properties of risk factors means to declare the emergence of new risk factors of interacting objects.

Having said all the above, we can now make a conclusion that application of the system-synergetic method forms a fresh view on the realm of investment in regional economies and opens new opportunities for investment risk assessment and management. The investment risk in a region is a weighted average of risk factors each one of which is, in its turn, a combination of sub-factors of risk. The significance and composition of sub-factors of risk for risk management are defined by regional policies and follow their changes.

Let us now identify the basic types of investment risk factors: economic, financial, political, social and legislative ones.

Having identified factors and risk factors that define investment potential and investment risk, how we have to choose mathematical instruments for the assessment. We consider investment attractiveness of a region from the point of view of the maximum investment potential and minimum investment risk.

#### 4 LOGICAL STOCHASTIC MATHEMATICAL MODELS

Commonly known stochastic mathematical models used in the economics do not allow us to adequately and reasonably assess and minimize regional investment risk. The paper proposes application of logical stochastic mathematical models such as failure scenario, emergencies and catastrophes, structural models or graphs of risk, logical models of risk, stochastic models of risk, and critical points for emergency forecast.

In the above listed models an important role is played by permissible values for parameters that are, usually, chance variables. To build the models cited above, we have to solve the following tasks:

- building of a scenario/structural model of risk;
- defining of attribute-events and gradation-events;
- defining of groups of incompatible events;
- distribution of discretization of accidental gradation events;
- generation of random discontinuous distributions;
- building of a logical model of risk;
- orthogonalization of a logical model of risk;
- building of a stochastic model of risk;
- normalization of event probabilities;
- optimization of a logical stochastic model of risk.
- defining of associations between risk parameters *Yad*, *Risk*, *Nad*, *Had*.

Now let us consider methods and techniques of solving the above tasks.

Building of a scenario/structural model of risk.

We can use here both the success risk scenario and the failure risk scenario. Probabilities of success and failure have a simple dependence and complement each other up to 1. Constructively we have to emphasize failure and build/use the scenario and logical stochastic models of failure risk. A scenario may have a physical basis or be associative, it can define all or a limited number of unsafe conditions of an investment program. The scenario is presented as a graph.

Defining of attribute-events and gradation-events.

Probabilities of attribute events and gradation events are given or defined by statistical data by the frequency of use of gradation events in various conditions, or are defined as a result of solving the task of identification according to statistical data.

Identification of groups of incompatible events and distribution discretization of accidental gradation events.

Discretization of a random variable can be natural or artificial. For instance, a random variable  $Z_j$  for the "purpose of investment" attribute is discretized naturally by gradations such as residential housing  $Z_{j1}$ , equipment  $Z_{j2}$ , communications  $Z_{j3}$ , etc., while a random variable of "return on equity"  $Z_i$ , divided by gradation intervals  $Z_{i1}, Z_{i2}, \dots, Z_{iN_i}$ , is discretized artificially. In some cases, for instance for investment risk assessment, both natural and artificial discretization is used (the possible total sum of investment is divided by intervals). In all cases, gradation events for one attribute of investment or yield on equity comprise a group of incompatible events whereby the sum of gradation probabilities events is 1.

Generation of random discontinuous distributions.

To test logical stochastic methods of risk analysis and assessment, and for the purpose of teaching of logical stochastic risk models, we have to generate gradation events for an attribute with random discretized distribution; for instance, gradation events of attributes of investment, return on equity, the values of influencing variables and the efficiency parameter. Random discrete distribution is obtained by summation of a number of elementary distributions generated according to different laws. For elementary distributions we shall use, for instance, normal law distribution, uniform law distribution, trapezoid law, law of increasing/decreasing line, Weibull law, etc.

The method for building a random discrete distribution is as follows:

1. Using the chosen elementary distribution law for attribute  $Z_j$ , generate randomly  $N$  values of the attribute within the range of its variation  $\{Z_{j \min}, Z_{j \max}\}$ .
2. Divide the obtained attribute values by  $N_j$  gradations.
3. Calculate frequencies-probabilities for these gradations by Formula 3.
4. Repeat steps 1 - 3 to generate the chosen elementary distributions, each of which also has  $N_j$  gradations.
5. Summarize the resulting various elementary distributions.

$$P_j = x_1 p_{1j} + x_2 p_{2j} + \dots + x_k p_{kj}, \\ j = 1, 2, \dots, N_j,$$

(3)

where:

$x_1, x_2, \dots, x_k$  - values of weight of the elementary distributions whose sum is 1;

$P_j$  - gradation probability of attribute  $j$ ;

$p_{1j}, \dots, p_{kj}$  - gradation probabilities of  $j$  elementary distributions.

Building of a logical model of risk.

A logical model of failure risk is written as a disjunctive or conjunctive normal form, i.e. as a logical statement with *OR*, *AND*, *NOT* operators, cycles and groups of incompatible events, but without brackets. A logical model of failure risk can be also written as an orthogonal disjunctive normal form or as a perfect disjunctive normal form. A logical model of failure risk defines all dangerous conditions of a system or a limited number of such.

Orthogonalization of a logical model of risk.

Orthogonalization allows us to proceed from a logical function of failure risk to a stochastic function of failure risk, in other words, from logical expressions to arithmetic expressions. The latter allow us to carry out qualitative assessment and to analyze risks.

Building of a stochastic model of risk

A stochastic model of failure risk is built after orthogonalization of a logical model of failure risk. A stochastic model of failure risk can define all dangerous conditions of a system or a limited number of such. This model allows us to carry out qualitative assessment and to analyze risks.

Normalization of event probabilities (conditions, states) is based on the assumption that their sum, by implication, is 1.

Event probabilities normalization is done in the following cases:

- while identifying (optimizing) a stochastic model of failure risk by statistical data for gradation events in groups of incompatible events;
- when there is statistical data for a limited set of system conditions or objects from the complete set of all probable conditions or objects;
- while building, by the Monte-Carlo method, models of a limited set of conditions (objects) from the complete set of possible conditions.

Normalization is done via dividing the probability of each event (condition) by the sum of probabilities of the event (condition) set under consideration.

Optimization (identification) of a logical stochastic model of risk.

When building a logical stochastic model of risk in systems containing groups of incompatible events, tasks of optimization of sets of objects and object conditions are solved. Optimization in an investment task means defining optimal shares of capital to be invested in the investment program. Optimization within the effectiveness task means defining of the weights of processes that influence the resulting process.

Defining of associations between risk parameters  $Y_{ad}$ , Risk,  $N_{ad}$ ,  $H_{ad}$ .

In systems containing groups of incompatible events the following risk-defining parameters are considered:

$Y_{ad}$  - allowed value of effectiveness parameter;

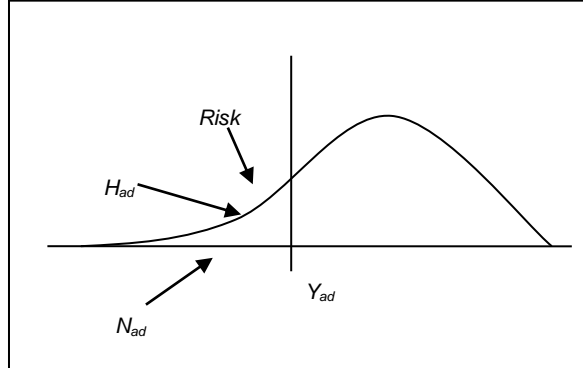


Fig. 1. Risk parameters in the distribution tail area

**Risk** - the probability of having the effectiveness parameter value that is smaller than permissible;

$N_{ad}$  - the number of objects (object conditions) in the tail area of distribution of the effectiveness parameter;

$H_{ad}$  - entropy of probabilities of objects (object conditions) in the tail area of distribution of the effectiveness parameter;

Calculation of a permissible value for output parameter  $Y_{ad}$  with the given value of Risk is a complicated algorithmic problem. Below we shall consider various methods of solving it.

**1. Interpolation.** We build a discrete differential distribution of the output parameter  $Y$ . For this purpose, its whole variance

range is divided by  $N_y$  intervals (gradations). The probabilities  $P_i$  of the value of the parameter at chosen intervals are summarized. Then, an integral discrete distribution of the parameter  $Y$  is build. After that we can calculate the permissible value  $Y_{ad}$  with the given value of Risk, using a linear interpolation formula.

**2. Sorting.** The sorting method is a simple and reliable method of calculation of the permissible value for an output parameter  $Y_{ad}$ . Value arrays of the  $Y_i$  parameter and its  $P_i$  probabilities from  $i = 1, 2, \dots, N$  values are sorted by the value of the output parameter  $Y_{ib}$  in the ascending order. Then, for arrays already sorted, we have to summarize probabilities  $P_{yi}$  of parameter  $Y_i$  values until the given value of Risk is obtained. The last summands of the sum of the array of probabilities is corresponding to the output parameter value which we have to take as the permissible value of  $Y_{ad}$ . The complexity of sorting depends on the number of conditions  $N$  of the output parameter  $Y_{ad}$ ; in practice the time spent on multiple optimization sorting is more or less acceptable.

**3. Bipartitioning.** The  $[Y_{min}, Y_{max}]$  interval is repeatedly divided into two equal parts  $[Y_{min}, Y_{1/2}]$  and  $[Y_{1/2}, Y_{max}]$ . For each of the parts, by way of summation, probabilities  $P_1 = P\{Y < Y_{1/2}\}$  and  $P_2 = P\{Y > Y_{1/2}\}$  and the number of objects in parts  $N_1$  and  $N_2$  are defined. The part containing the value Risk is again bisected. The procedure goes on and on until the number of conditions in one part = 1 object. With  $N = 1000$  objects, the search of  $Y_{ad}$  by bipartitioning proceeds threefold faster than sorting.

The  $N_{ad}$  parameter defines the number of conditions of the output parameter  $Y_{ad}$  that are in the tail of distribution, i.e. when  $Y_i < Y_{ad}$ . This is a very important risk characteristic because it is a whole and can be calculated to a precision of 1. From this follows that we can solve the problem of optimization, investment program risk assessment by using not the objective  $Y_{ad}$ , function, but its equivalent – the objective  $N_{ad}$  function.

Entropy  $H_{ad}$  is another characteristic of the distribution tail area (Shannon entropy). Degree of nonhomogeneity or diversity of sets of objects or conditions depends on the total number of objects in a set, on the number of different objects and their probabilities in this set.

To measure the diversity of objects or conditions of an object in the tail area we'll use the entropy defined by the expression

$$H_{ad} = - \sum_{i=1}^{N_{ad}} P_i \ln P_i, \quad (4)$$

where:

$H_{ad}$  - entropy;

$P_i$  - probability  $i$  of an object or the condition of an object in the tail area of distribution;

$N_{ad}$  - number of objects or object conditions in the tail area. Summation is done for all objects in the tail area.

Entropy proves itself quite well as a measure of diversity in the most general case because it has the following features:

1. It becomes zero when occurrence of one element in a set is certain while for other elements it is impossible.
2. It has its maximum with a given number of different elements when occurrence of these elements is equally probable.

3. It increases when the number of elements in the set increases.
4. It has additivity properties, i.e. when a set of independent elements-events is joined into one, their entropy sums up and the result is the entropy of the joint set.

As has been proved by A.Y.Khinchin, entropy is the only function that demonstrates such properties. It should be noted that the logical stochastic theory of risk can be presented as a theory of integers with arithmetic operations of summation/division of whole numbers.

Let us now consider the method of building logical-and-probabilistic risk models containing a group of incompatible investment events/cost-efficiency events, used for the management of social and economic processes.

*Logical-and-probabilistic risk models containing a group of incompatible investment events.* A logical-and-probabilistic risk model for a securities portfolio is build by introducing discontinuous distributions (gradations) of ROI for assets  $Z_1, \dots, Z_j, \dots, Z_n$  (a random distribution). Gradation events for each of the assets will form a group of incompatible events. The task of choosing an optimal portfolio lies in the process of defining, on the basis of statistical data concerning the assets' ROI dynamics, of appropriate capital shares  $x_1, x_2, \dots, x_n$  invested in the assets. The optimization criteria by a logical-probabilistic VaT (LP- VaR) is the maximum acceptable ROI of a portfolio Y with the specified Risk value. Portfolio management is done by way of changing capital shares  $x_1, x_2, \dots, x_n$  in the assets, and by the contribution of gradation events in the distribution tail-area of the portfolio Y's ROI [7].

*A logical-and-probabilistic risk model containing a group of incompatible events linked to the cost-efficiency problem.* According to James J. Heckman, the Nobel Prize winner, the cost-efficiency parameter for management of social economic processes depends on the influencing variables  $Z_1, \dots, Z_j, \dots, Z_n$ , having different nature and dimension; it also has multivariable distribution. To solve the problem we have to make a transition from the continuous to discontinuous distribution of random variables. For this purpose, the influencing variables and the cost-efficiency parameter are broken up into intervals  $N_1, N_2, \dots, N_j$  and  $N_y$  which are considered to be gradations. The problem of optimization by statistical data is formulated as the problem of defining appropriate weights  $x_1, x_2, \dots, x_n$  of the parameters that influence the Y's efficiency. After that we introduce the following criteria: the acceptable value for the risk and cost-efficiency parameter; our goal here is to obtain it at its smallest. Risk management is done on the basis of the values of weights  $x_1, x_2, \dots, x_n$  and the contribution of gradation events in the tail-area of the distribution of cost-efficiency parameter Y [7].

Logical-and-probabilistic models can be used for the development of scenarios of failure, emergency, disasters/accidents at industrial enterprises, which will allow us to evaluate their stability.

## 5 CONCLUSION

Attracting investors to the Russian market is a hard task because attempts to assess regional investment activities

have been rather rough than accurate. Unified approaches to interpretation and composition of indicators are inexistent. The worst problem here is that there are no unambiguous assessment of investment climate and risks of a region. By doing an integral assessment of investment attractiveness of regions, by reducing all indicators to a complex one, by ranging regions according to this complex indicator, we will be able to talk about objective, verifiable assessment of the investment climate in each of such regions and about its rank among all other regions of Russia. This indicator allows us to compare variances in the levels of investment climate per region in addition to their individual ranks on this rating scale. Having only these ranks we cannot reveal to which extent one region excels other ones or yields to them, because when we range an attribute between two adjacent regions the variance may be both large of small; ratings or ranks do not reveal this. Logical stochastic mathematical models of investment risk assessment allow us to supplement and refine the above analysis. This approach will allow a potential investor to take an informed decision with a minimized risk of getting poor investment results. As a conclusion it should be noted that the method of logical stochastic risk assessment, proposed in this paper, was applied to justification of risk assessment during development of an investment program for the North-western Federal District of the Russian Federation.

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